

CLAIMS:

1. A method for determining the virgin formation pressure at a particular depth region of earth formations surrounding a borehole drilled using drilling mud, and on which a mudcake has formed, comprising the steps of:

keeping track of the time since cessation of drilling at said depth region;

deriving formation permeability at said depth region;

causing wellbore pressure to vary periodically in time and determining, at said depth region, the periodic component and the non-periodic component of pressure measured in the formations adjacent the mudcake;

determining, using said time, said periodic component and said permeability, the formation pressure diffusivity and transmissibility and an estimate of the size of the pressure build-up zone around the wellbore at said depth region of the formations;

determining, using said time, said formation pressure diffusivity and transmissibility, and said non-periodic component, the leak-off rate of the mudcake at said depth region;

determining, using said leak-off rate, the pressure gradient in the formations adjacent the mudcake at said depth region; and

extrapolating, using said pressure gradient and said size of the pressure build-up zone, to determine the virgin formation pressure.

2. The method as defined by claim 1, wherein said step of determining the periodic component and non-periodic component of pressure measured in the

formations adjacent the mudcake includes providing a formation testing device at said depth region, and measuring formation pressure with a probe of said device that is inserted through the mudcake into the formations adjacent the mudcake.

3. The method as defined by claim 2, wherein said step of determining the periodic component and non-periodic component of said pressure measured in formations adjacent the mudcake includes determining, from an average of the pressure measured with said probe, said non-periodic component, and determining, from variations from said average, said periodic component.

4. The method as defined by claim 3, wherein said step of providing a formation testing device comprises providing said device on a wireline in said borehole.

5. The method as defined by claim 3, wherein said step of providing a formation testing device comprises providing said device on a drill string in said borehole.

6. A method for determining the virgin formation pressure at a particular depth region of earth formations surrounding a borehole drilled using drilling mud, and on which a mudcake has formed, comprising the steps of:

causing wellbore pressure to vary periodically in time;

determining, at said depth region, the periodic component and the non-periodic component of pressure measured in the formations adjacent the mudcake;

determining, using said periodic component, an estimate of the size of the pressure build-up zone around the wellbore at said depth region of the formations;

determining, using said non-periodic component, the leak-off rate of the mudcake at said depth region; and

determining, using said leak-off rate, and said size of the pressure build-up zone, the virgin formation pressure.

7. The method as defined by claim 6, wherein said step of determining, using said leak-off rate, the virgin formation pressure, includes determining, from said leak-off rate, the pressure gradient in the formations adjacent the mudcake at said depth region, and extrapolating, using said pressure gradient and said size of the pressure build-up zone, to determine said virgin formation pressure.

8. The method as defined by claim 7, further comprising the step of keeping track of the time since cessation of drilling at said depth region, and wherein said time is used in said step of determining an estimate of the size of said pressure build-up zone and in said step of determining said pressure gradient.

9. The method as defined by claim 6, wherein said step of determining the periodic component and non-periodic component of pressure measured in the formations adjacent the mudcake includes providing a formation testing device at said depth region, and measuring formation pressure with a probe of said device that is inserted through the mudcake into the formations adjacent the mudcake.

10. The method as defined by claim 9, wherein said step of determining the periodic component and non-periodic component of said pressure measured in formations adjacent the mudcake includes determining, from an average of the pressure measured with said probe, said non-periodic component, and determining, from variations from said average, said periodic component.

11. The method as defined by claim 9, wherein said step of providing a formation testing device comprises providing said device on a wireline in said borehole.

12. A method for determining the virgin reservoir pressure at a particular depth region of earth formations surrounding a borehole drilled using drilling mud, and on which a mudcake has formed, comprising the steps of:

- keeping track of the time since cessation of drilling;

- deriving formation permeability at said depth region;

- causing wellbore pressure to vary periodically in time, and measuring, at said depth region, the time varying pressure in the borehole and the time varying pressure in the formations adjacent the mudcake;

- determining, at said depth region, an estimate of the flow resistance of the mudcake from said derived permeability and components of said measured pressure in the borehole and said measured pressure in the formations adjacent the mudcake;

determining, at said depth region, the leak-off rate of the mudcake from said estimated flow resistance and said measured pressure in the borehole and said measured pressure in the formations adjacent the mudcake;

determining, at said depth region, the pressure excess in the formations adjacent the mudcake from said derived permeability, said leak-off rate, and said time since cessation of drilling; and

determining, at said depth region, the virgin reservoir pressure from said measured pressure in the formations adjacent the mudcake and said pressure excess in the formations.

13. The method as defined by claim 12, wherein said step of measuring the time varying pressure in the borehole and the time varying pressure in the formations adjacent the mudcake includes providing a formation testing device at said depth region, and measuring formation pressure with a probe of said device that is inserted through the mudcake into the formations adjacent the mudcake.

14. The method as defined by claim 13, wherein said step of providing a formation testing device comprises providing said device on a wireline in said borehole.

15. The method as defined by claim 13, wherein said step of providing a formation testing device comprises providing said device on a drill string in said borehole.

16. A method for determining the leak-off rate of a mudcake formed, at a particular depth region, on a borehole drilled in formations using drilling mud, comprising the steps of:

deriving formation permeability at said depth region;

causing wellbore pressure to vary periodically in time, and measuring, at said depth region, the time varying pressure in the borehole and the time varying pressure in the formations adjacent the mudcake;

determining, at said depth region, an estimate of the flow resistance of the mudcake from said derived permeability and components of said measured pressure in the borehole and said measured pressure in the formations adjacent the mudcake; and

determining, at said depth region, the leak-off rate of the mudcake from said estimated flow resistance and said measured pressure in the borehole and said measured pressure in the formations adjacent the mudcake.

17. The method as defined by claim 16, wherein said step of measuring the time varying pressure in the borehole and the time varying pressure in the formations adjacent the mudcake includes providing a formation testing device at said depth region, and measuring formation pressure with a probe of said device that is inserted through the mudcake into the formations adjacent the mudcake.

18. The method as defined by claim 17, wherein said step of providing a formation testing device comprises providing said device on a wireline in said borehole.

19. The method as defined by claim 17, wherein said step of providing a formation testing device comprises providing said device on a drill string in said borehole.

20. The method as defined by claim 16 further comprising:

determining over a time interval a circulation rate and a corresponding overbalance pressure of the borehole;

determining, over the time interval, the leak-off rate for each circulation rate and corresponding overbalance pressure of the borehole;

determining, over the time interval, a relationship between the leak-off rate and each circulation rate and corresponding overbalance pressure; and

estimating the leak-off rate for a previous time interval based on the determined relationship.

21. The method as defined by claim 20 further comprising:

adjusting the measured formation pressure based on the estimated leak-off rate.